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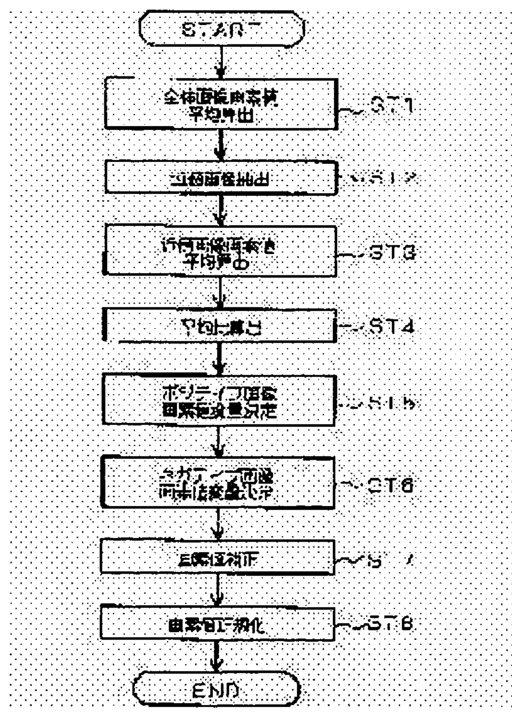
(54) PICTURE QUALITY IMPROVING METHOD, EDGE INTENSITY CALCULATING METHOD AND DEVICE THEREFOR



(57)Abstract:

PROBLEM TO BE SOLVED: To emphasize both local and global contrasts and to improve the image quality by simply calculating without needing a user's judgment.

SOLUTION: In this method, the mean value Vmean of an entire luminance value of an image is founed, the average value Vave of neighborhood luminance values vl to vi of each pixel of the image is found, positive pixel variable δposi is founed by multiplying a relative value of the value Vave of a positive image by a coefficient that corresponds to the ratio of the value Vmean to the value Vave, negative pixel variable δnega is founed by multiplying the relative value of the value Vave of a negative image by the coefficient, the variable δposi is corrected by adding it to the relative value of the pixel of the positive image, the variable δnega is corrected by adding it to the relative value of the pixel of the negative image, the luminance value (v) of the pixel is corrected by the logarithm of the ratio of each modified absolute value and normalizes a corrected result k (v) within the output range.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Emphasizing the delicate brightness value change in a bright section and dark space to the input image from image sensors, a digital camera, etc., it emphasizes local contrast and global contrast simultaneously, and this invention relates to the image quality improvement approach, the edge on-the-strength count approach, and equipment which are fitted to an output range and may be outputted.
[0002]
[Description of the Prior Art] Generally, in the vision technical field accompanied by image **** or image display, since a higher definition image is required, the image quality improvement approach of changing an input image into the highly precise possible image is needed, without minding special actuation of human being.
[0003] As this kind of the image quality improvement approach, there are the approach of carrying out linear transform of each pixel value of an image, a characteristic conversion approach represented by the gamma correction, and the logarithmic transformation approach. Moreover, there is the approach of carrying out contrast stretching of the pixel value of an image etc. by histogram flattening to emphasize an image extremely.
[0004] Moreover, according to people's brightness sensibility characteristic curve, a range is divided at some sections, the segment approximated to the curve for every section is searched for, those segments are combined, and there is the piecewise linear conversion approach of changing a pixel value etc. (a tree, the Shimoda (editorial supervision) "image-analysis handbook", University of Tokyo Press, 1991).
[0005] Here, by the approach by linear transform, as shown in drawing 15 , by dividing the section of the pixel value I of an input image into some partitions, and changing the inclination of a segment in each section, the dynamic range of an output is made to fluctuate dividing and contrast is emphasized.
[0006] Moreover, by the approach by logarithmic transformation, as shown in drawing 16 , it changes into the side which increases the pixel value I of an input image to the whole. In addition, the fact that the one where a pixel value is smaller has a large increment shows that the contrast of dark space is mainly emphasized so that it may illustrate.
[0007] Furthermore, by the approach by characteristic conversion, as shown in drawing 16 , when a characteristic is smaller than 1, the same conversion curve as logarithmic transformation is drawn, and it changes into the side which increases a pixel value to the whole. Therefore, the contrast of dark space is emphasized. On the other hand, when a characteristic is larger than 1, as shown in drawing 17 , it changes into the side which reduces a pixel value to the whole. Therefore, the contrast of a bright section is emphasized.
[0008] The contrast stretching of considerable extent is possible for the approach by piecewise linear conversion by subdividing the section and raising curvilinear order of approximation.
[0009] The approach by histogram flattening is the technique of distributing the lump of distribution of a pixel value suitable for a perimeter, **(ing) to distribution, and performing contrast stretching, and is the

technique in which an enhancement effect is remarkable, also in the various image enhancement technique actually.
[0010] As the image enhancement approach excellent in resolution enhancement besides these, the image quality improvement approach and equipment of emphasizing contrast are indicated by JP,8-21079,B by the bright section and dark space in pars intermedia with sufficient visibility from the first, controlling contrast to some extent.
[0011]
[Problem(s) to be Solved by the Invention] However, there are the following problems by the above image quality improvement approaches.
[0012] By the approach by linear transform, while a user makes a visual judgment, in order to determine the fractionation section and to decide the inclination in each section for every image of a processing object, there is a problem of being special.
[0013] By the approach by logarithmic transformation, although the contrast of the section where a pixel value is small is emphasized, there is a problem by which the contrast of the section where a pixel value is large is controlled.
[0014] By the approach by characteristic conversion, although the time and effort as which a user judges it for every image, and determines a characteristic is taken, and the contrast of the section where a pixel value is small is emphasized when a characteristic is smaller than 1, there is a problem by which the contrast of the section where a pixel value is large is controlled. Moreover, although the contrast of the section where a pixel value is large is emphasized when a characteristic is larger than 1, there is a problem by which the contrast of the section where a pixel value is small is controlled.
[0015] Moreover, a piecewise linear conversion method has the problem which is not [that computational complexity is huge and] realistic.
[0016] By the approach by histogram flattening, while the enhancement effect of global contrast is remarkable, there is a problem by which the local contrast small in comparison which shows the change inside a field etc. is controlled.
[0017] Moreover, by the approach given in JP,8-21079,B, while a sharp image is locally obtained from the enhancement effect of local contrast being high, there is an inclination to reduce global contrast.
[0018] This invention was not made in consideration of the above-mentioned actual condition, and without requiring decision of a user, by easy count, the contrast of a global-area target's both sides is emphasized, and it aims at local and offering the image quality improvement approach, the edge on-the-strength count approach, and equipment which may improve image quality.
[0019]
[Means for Solving the Problem] The 1st main point of this invention is explained. In order to amend the response characteristic of the S character mold in human being's vision to linearity, reverse type conversion of S characters is used for the technique indicated by JP,8-21079,B, but while it emphasizes local contrast as it was mentioned above, it has the inclination to reduce global contrast.
[0020] In order to improve this inclination, in this invention, improvement in global contrast is in drawing, maintaining local contrast by asking for the multiplier corresponding to the ratio of local brightness (the average vave of the brightness near the pixel) from the brightness (the average vmean of the whole brightness) of the whole image, and emphasizing the difference of the whole brightness and local brightness.
[0021] Moreover, this invention takes into consideration that the receptive field in human being's lateral inhibition device is an abbreviation concentric circle-like, and is the average vave of the brightness near the pixel about the local brightness of an image. It is made to be shown and the improvement of the local contrast itself is also aimed at.
[0022] Next, the 2nd main point of this invention is explained.
[0023] It is the mean value Vmid of the output range of a display system about the correction value k (vmean) which was made to represent the overall brightness of an image with the average vmean of a brightness value, and carried out reverse type conversion of S characters of this by consideration of an adaptation-to-luminosity device in such 1st main point in order to aim at emphasis of global contrast

further. Emphasis of global contrast is in drawing by making it correspond, and performing linear transform so that an output range may be made to suit before and behind average luminance.

[0024] Next, the 3rd main point of this invention is explained.

[0025] In the 1st main point mentioned above, improvement in the edge enhancement effect of both a bright section and dark space is in drawing by emphasizing change of the dark section, and change of the bright section using the differential form of reverse type conversion of S characters. In addition, the maximum inclination value dv between pixels (v) is used for change of the section soon.

[0026] Now, based on the main point of this invention mentioned above, the following solution means are specifically realized.

[0027] Invention corresponding to claim 1 calculates the average vmean of the brightness value v of the whole image pixel. The average vave of the brightness values [the whole pixel of said image / near the pixel concerned] v1-vi of i pieces It asks. It asks for the multiplier corresponding to the ratio of the average vmean of said whole, and the average vave of said near, and is the average vave near [said] the positive image about said multiplier. While taking advantaging of a relative value and calculating positive pixel variate deltaposi It is the average value vave near [said] the negative image about said multiplier. Take advantaging of a relative value and negative pixel variate deltanega is calculated. While adding said positive pixel variate deltaposi to the relative value of the brightness value of the pixel concerned in a positive image and correcting this relative value Add said negative pixel variate deltanega to the relative value of the brightness value of the pixel concerned in a negative image, and this relative value is corrected. It is the image quality improvement approach of amending the brightness value v of the pixel concerned and normalizing this amendment result k (v) within the limits of an output range by the logarithm of the ratio of the these-corrected relative value.

[0028] Moreover, it sets to the image quality improvement approach corresponding to claim 1, and invention corresponding to claim 2 is the mean value Vmid of said output range about the amendment result k of the average value vmean of said whole (vmean) as said normalization. It is the image quality improvement approach performed so that it may be made to correspond.

[0029] Furthermore, invention corresponding to claim 3 calculates the average vmean of the brightness value v of the pixel of the whole image. The average vave of the brightness values [the whole pixel of said image / near the pixel concerned] v1-vi of i pieces It asks. The average vmean of said whole, and the average vave of said near It asks for the multiplier corresponding to a ratio, and is the average vave near [said] the positive image about said multiplier. While taking advantaging of a relative value and calculating positive pixel variate deltaposi It is the average value vave near [said] the negative image about said multiplier. Take advantaging of a relative value and negative pixel variate deltanega is calculated. While adding said positive pixel variate deltaposi to the relative value of the brightness value v of the pixel concerned in a positive image and correcting this relative value Add said negative pixel variate deltanega to the relative value of the brightness value v of the pixel concerned in a negative image, and this relative value is corrected. Furthermore, the upper and lower sides between each brightness value v1 of said near - vi, right and left, left slant, While calculating the maximum inclination value dv (v) which shows max among the absolute values of each inclination which met in the four directions of right slant, being as a result of [of the relative value in said positive image] correction, ** (ing) this maximum inclination value dv (v) and calculating the edge value of a positive image on the strength Are as a result of [of the relative value in said negative image] correction, ** the maximum inclination value dv concerned (v), and the edge value of a negative image on the strength is calculated. It is the edge on-the-strength count approach of computing the edge reinforcement of the pixel concerned by applying mutually both [these] the edge value on the strength, and normalizing this calculation result dk (v) within the limits of an output range.

[0030] Moreover, an image input means for invention corresponding to claim 4 to input the [a] image, [b] A whole averaging means to compute the whole average vmean by averaging the brightness value of all the pixels of the image inputted by said image input means, [c] A near image extract means to extract the brightness value v of the pixel concerned, and the brightness values v1-vi of i pixels in the near for every pixel of the image inputted by said image input means, [d] The brightness values v1-vi of the near

pixel extracted by said near image extract means are averaged, and it is the average vave soon. A near averaging means to compute, [e] The whole average vmean computed by said whole averaging means, and the near average vave computed by said near averaging means A multiplier calculation means to compute the multiplier corresponding to a ratio, [f] The brightness value v of the pixel concerned extracted by said near image extract means The near average vave computed by the whole average vmean computed by said whole averaging means, and said near averaging means And a positive image pixel value variate decision means to determine pixel value variate deltaposi of a positive image based on the multiplier computed by said multiplier calculation means, [g] The brightness value v of the pixel concerned extracted by said near image extract means The near average vave computed by the whole average vmean computed by said whole averaging means, and said near averaging means And a negative image pixel value variate decision means to determine pixel value variate deltanega of a negative image based on the multiplier computed by said multiplier calculation means, [h] Based on each of pixel value variate deltanega determined by pixel value variate deltaposi determined by said positive image pixel value variate decision means, and said negative image pixel value variate decision means, the brightness value v of the pixel concerned is amended, respectively. A pixel value amendment means to compute pixel correction value k (v) in quest of the logarithm of the ratio of each amendment result, [j] The maximum kmax among all pixel correction value k (v) computed by said pixel amendment means, and the minimum value kmin A correction value maximum minimum value calculation means to compute, [l] Maximum kmax computed by said correction value maximum minimum value calculation means And the minimum value kmin It is based. A pixel value normalization means to compute normalization conversion value V (v) by normalizing pixel correction value k (v) computed by said pixel value amendment means within the limits of an output range, [m] It is image quality improvement equipment equipped with an image output means to constitute and output the whole image based on normalization conversion value [of each pixel computed by said pixel value normalization means] V (v).

[0031] Furthermore, invention corresponding to claim 5 is set to the image quality improvement equipment corresponding to claim 4. The whole average vmean which replaced with said pixel value normalization means and said image output means, and was computed by the whole [a] aforementioned averaging means A whole average correction value calculation means to compute the correction value k of said whole average vmean (vmean) based on the multiplier computed by the near average vave computed by said near averaging means, and said multiplier calculation means, [b] The correction value k (vmean) computed by pixel correction value [of each pixel computed by said pixel value amendment means] k (v) and said whole average correction value calculation means is compared. At the time of k (v) <k (vmean), it is the mean value Vmid of output range within the limits about pixel correction value k (v). Linear transform is carried out to the small output range section. At the time of k(v) =k (vmean), it is the mean value Vmid of an output range about pixel correction value k (v). It changes. At the time of k(v) >k (vmean), it is the mean value Vmid of output range within the limits about pixel correction value k (v). By carrying out linear transform to the large output range section A pixel correction value conversion means to compute normalization conversion value V (v) by normalizing each pixel correction value k (v) within the limits of an output range, [c] It is image quality improvement equipment equipped with a normalization image output means to constitute and output the whole image based on normalization conversion value [of each pixel computed by said pixel correction value conversion means] V (v).

[0032] Furthermore, an image input means for invention corresponding to claim 6 to input the [a] image, [b] A whole averaging means to compute the whole average vmean by averaging the brightness value of all the pixels of the image inputted by said image input means, [c] A near image extract means to extract the brightness value v of the pixel concerned, and the brightness values v1-vi of i pixels in the near for every pixel of the image inputted by said image input means, [d] The brightness values v1-vi of the near pixel extracted by said near image extract means are averaged, and it is the average vave soon. A near averaging means to compute, [e] The whole average vmean computed by said whole averaging means, and the near average vave computed by said near averaging means A multiplier calculation means to

compute the multiplier corresponding to a ratio, [f] The brightness value v of the pixel concerned extracted by said near image extract means The near average vave computed by the whole average vmean computed by said whole averaging means, and said near averaging means And a positive image pixel value variate decision means to determine pixel value variate deltaposi of a positive image based on the multiplier computed by said multiplier calculation means, [g] The brightness value v of the pixel concerned extracted by said near image extract means The near average vave computed by the whole average vmean computed by said whole averaging means, and said near averaging means And a negative image pixel value variate decision means to determine pixel value variate deltanega of a negative image based on the multiplier computed by said multiplier calculation means, [h] The upper and lower sides between each brightness value v1 of the near pixel extracted by said near image extract means - vi, A near pixel maximum inclination value calculation means to compute the maximum inclination value dv (v) which shows max among the absolute values of each inclination which met in the four directions of right and left, left slant, and right slant, [j] While adding pixel value variate deltaposi determined by said positive image pixel value variate decision means to the relative value of the brightness value v of the pixel concerned in a positive image and correcting this relative value A positive image edge on-the-strength value calculation means to compute a positive image edge value on the strength by being as a result of [concerned] correction, and **(ing) the maximum inclination value dv (v) computed by said near pixel maximum inclination value calculation means, [l] While adding pixel value variate deltanega determined by said negative image pixel value variate decision means to the relative value of the brightness value v of the pixel concerned in a negative image and correcting this relative value A negative image edge on-the-strength value calculation means to compute a negative image edge value on the strength by being as a result of [concerned] correction, and **(ing) the maximum inclination value dv (v) computed by said near pixel maximum inclination value calculation means, [m] with the positive image edge value on the strength computed by said positive image edge on-the-strength value calculation means, and said negative image edge on-the-strength value calculation means An edge on-the-strength calculation means to compute the edge value dk of the pixel concerned on the strength (v) by applying mutually the computed negative image edge value on the strength, [n] An edge on-the-strength normalization means to compute the normalization conversion value dV (v) by normalizing the edge value dk of each pixel computed by said edge on-the-strength calculation means on the strength (v) within the limits of an output range, [o] It is edge on-the-strength count equipment equipped with an edge on-the-strength image output means to constitute and output the whole image based on the normalization conversion value dV of each pixel computed by said edge on-the-strength normalization means (v).

[0033] (Operation) Invention corresponding to claim 1 and claim 4 therefore, by having provided the above means By calculating the inputted whole image average vmean, without assuming the distribution property of the brightness value of the inputted image in advance Since the degree which is adapted for distribution of the local brightness values v1-vi, and emphasizes contrast can be adjusted only by processing near [each] the pixel, image quality can be raised by easy count, without requiring decision of a user.

[0034] Moreover, it adds to the operation corresponding to claim 1, and invention corresponding to claim 2 and claim 5 is the highly sensitive mean value Vmid of an output range about the correction value k of the whole average value vmean (vmean). It matches, and since it normalizes, local contrast and global contrast can be emphasized simultaneously.

[0035] Furthermore, since invention corresponding to claim 3 and claim 6 computes edge reinforcement after the same contrast stretching as claim 1 and claim 4, without requiring decision of a user to the image of most including the object and structure of a bright section and dark space fine at both, by easy count, it can perform calculation and edge detection of accurate edge reinforcement, and can output the outstanding edge enhancement image.

[0036]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing.

[0037] (Gestalt of the 1st operation) Drawing 1 is the block diagram showing the configuration of the image quality improvement equipment concerning the gestalt of operation of the 1st of this invention. This image quality improvement equipment The image input section 1, the whole averaging section 2, the near image extract section 3, the near averaging section 4, the multiplier calculation section 5, the positive image pixel value variate decision section 6, the negative image pixel value variate decision section 7, the pixel value amendment section 8, the pixel value amendment control section 9, the pixel correction value storage section 10, the pixel correction value maximum minimum value calculation section 11, It has the pixel value normalization section 12, the pixel value normalization control section 13, the pixel value normalization conversion value storage section 14, and the image output section 15. Moreover, the data obtained with the component of the preceding paragraph are usable at a latter component.

[0038] Here, an image is inputted and saved, the whole averaging section 2, the near averaging section 3, etc. to read-out is possible for the image input section 1, for example, image sensors, a monitor camera, or its digital camera is usable suitably.

[0039] the function for the whole averaging section 2 to compute the whole average vmean by averaging the brightness value (pixel value) of all the pixels of the image inputted in the image input section, and to give this whole average vmean to the multiplier calculation section 5 -- **** -- it is.

[0040] The image extract section 3 has the function which extracts the brightness value v of the pixel concerned, and the brightness values v1-vi of i pixels in the near, and will be given to the averaging section 4 soon soon for every pixel of the image inputted in the image input section 1.

[0041] the brightness values v1-vi of the near pixel from which the averaging section 4 was extracted by the image extract section 3 soon -- averaging -- near average value vave computing -- this near average value vave the function given to the multiplier calculation section 5, the positive image pixel value variate decision section 6, and the negative image pixel value variate decision section 7 -- **** -- it is.

[0042] The multiplier calculation section 5 is the near averaging section to the whole averaging section 2 to the whole carrier beam average vmean, and the average vave near the carrier beam. Corresponding to a ratio, multiplier alphaposi of a positive image and multiplier alphanega of a negative image are computed, and it has the function to give multiplier alphaposi to the positive image pixel value variate decision section 6, and the function to give multiplier alphanega to the negative image pixel value variate decision section 7.

[0043] The brightness value v of the pixel concerned from which the positive image pixel value variate decision section 6 was extracted by the image extract section 5 soon The near average vave computed by the whole average vmean computed by the whole averaging section 2 and the near averaging section 4 And based on multiplier alphaposi computed by the multiplier calculation section 5, pixel value variate deltaposi of a positive image is determined, and it has the function to give this pixel value variate deltaposi to the pixel value amendment section 8.

[0044] The brightness value v of the pixel concerned from which the negative image pixel value variate decision section 7 was extracted by the image extract section 3 soon The near average vave computed by the whole average vmean computed by the whole averaging section 2 and the near averaging section 4 And based on multiplier alphanega computed by the multiplier calculation section 5, pixel value variate deltanega of a negative image is determined, and it has the function to give this pixel value variate deltanega to the pixel value amendment section 8.

[0045] The pixel value amendment section 8 amends the brightness value v of the pixel concerned based on each of pixel value variate deltanega determined by pixel value variate deltaposi and the negative image pixel value variate decision section 7 which were determined by the positive image pixel value variate decision section 6, respectively. Pixel correction value k (v) is computed in quest of the logarithm of the ratio of each amendment result, and it has the function to give this pixel correction value k (v) to the pixel value amendment control section 9.

[0046] The pixel value amendment control section 9 has the function to give pixel correction value k (v) received from the pixel value amendment section 8 to the pixel correction value storage section 10, and the function which will control the image extract section 3 thru/or the pixel value amendment section 8

soon to compute pixel correction value k (v) about all pixels.
[0047] The pixel correction value storage section 10 stores in memory etc. each pixel correction value k (v) received from the pixel value amendment control section 9, and the pixel correction value maximum minimum value calculation section 11 and a pixel value normalization means to read-out is possible for it.
[0048] The pixel correction value maximum minimum value calculation section 11 is the maximum kmax among all pixel correction value k (v) memorized in the pixel correction value storage section 10. Minimum value kmin It has the function which is computed and is given to the pixel value normalization section 12.
[0049] maximum kmax which receives the pixel value normalization section 12 from the pixel correction value maximum minimum value calculation section 11 And the minimum value kmin the function are based, normalize pixel correction value [of each pixel computed by the pixel value amendment section 8] k (v) within the limits of an output range, compute normalization conversion value V (v), respectively, and give these normalization conversion value V (v) to the pixel value normalization control section 13 -- **** -- it is.
[0050] The pixel value normalization control section 13 has the function to give normalization conversion value V (v) received from the pixel value normalization section 12 to the pixel value normalization conversion value storage section 14, and the function which controls the pixel value normalization section 12 to compute normalization conversion value V (v) about all pixels.
[0051] The pixel value normalization conversion value storage section 14 stores in memory etc. each normalization conversion value V (v) received from the pixel value normalization control section 13, and the image output section 15 to read-out is possible for it.
[0052] The image output section 15 has the function which constitutes and outputs the whole image based on normalization conversion value [of each pixel memorized in the pixel value normalization conversion value storage section 14] V (v).
[0053] Next, the image quality improvement approach by the image quality improvement equipment constituted as mentioned above is explained using the flow chart of drawing 2 .
[0054] First, an image is inputted by the image input sections 1, such as image sensors, a monitor camera, and a digital camera. At this time, it is vU about vL and an upper limit in the minimum of the domain which each pixel value of an input image can take. It shall express.
[0055] It computes the whole input image average vmean by the whole averaging section 2 adding the total pixel value of an input image, and doing the division of the addition result with the total number of pixels (ST1).
[0056] More soon than the input section 1, the image extract section 3 will extract the near field of reception and the number of pixels given or defined suitably, and will use an image as an image soon (ST2).
[0057] As the nearby simplest example is about [pixel / to observe] eight and is shown in drawing 3 , the pixel value of an attention pixel shall be set to v, and the pixel value [/ near the attention pixel] of eight pieces shall be expressed with the sign of either v1-v8, respectively. Moreover, drawing 4 is the mimetic diagram showing the relation between the whole image, an attention pixel, and its near pixel. Hereafter, the example which made the near pixel eight pieces is explained.
[0058] From the image extract section 3, the averaging section 4 will average the pixel value of an image for an image soon, as shown in reception and the following (1) type, and it is the average vave soon. It computes (ST3).
[0059]
[Equation 1]

$$v_{ave} = \sum_{i=1}^{8} vi \Big/ 8 \qquad \cdots (1)$$

[0060] The multiplier calculation section 5 is the average vave from reception and the near averaging

section 4 about the whole average vmean in the whole averaging section 2 soon. As shown in reception, the following (2) types, and (3) types, those ratios are computed (ST4) and it is referred to as negative pixel value correction factor alphanega with positive pixel value correction factor alphaposi.

[0061]

[Equation 2]

$$\alpha\,\mathrm{posi} = \frac{v_{ave} - v_L}{v_{mean} - v_L} \quad \cdots (2)$$

$$\alpha\,\mathrm{nega} = \frac{v_U - v_{ave}}{v_U - v_{mean}} \quad \cdots (3)$$

[0062] The positive image pixel value variate decision section 6 is the pixel value average vave from the averaging section 4 soon. From reception and the multiplier calculation section 5, about pixel value correction factor alphaposi, as shown in reception and the following (4) types, it is the pixel value lower limit vL of an input image. What computed the difference is multiplied by pixel value correction factor alphaposi, suitable constant betaposi is added, and it is referred to as positive image pixel value variate deltaposi (ST5).

[0063]

delta posi=alpha posi(vave-vL)+betaposi -- (4)

The negative image pixel value variate decision section 7 is the pixel value average vave from the averaging section 4 soon. From reception and the multiplier calculation section 5, about pixel value correction factor alphanega, as shown in reception and the following (5) types, it is the pixel value upper limit vU of an input image. What computed the difference is multiplied by pixel value correction factor alphanega, suitable constant betanega is added, and it is referred to as negative image pixel value variate deltanega (ST6).

[0064]

delta nega=alpha nega(vU-vave)+betanega -- (5)

The pixel value amendment section 8 positive image pixel value variate deltaposi from the positive image pixel value variate decision section 6 Reception, From the negative image pixel value variate decision section 7, as shown in reception and the following (6) types, negative image pixel value variate deltanega Lower limit vL of the pixel value v of an attention pixel to an image Add positive image pixel value variate deltaposi to the deducted value, and positive image pixel value correction value is calculated. moreover, upper limit vU of an image Add negative image pixel variate deltanega to the value which deducted the pixel value v of an attention pixel, and negative image pixel value correction value is calculated. from -- Positive image pixel value correction value is broken by negative image pixel value correction value, it asks for a ratio, the logarithm (natural logarithm) of the ratio is computed further, and it is referred to as pixel correction value k (v) (ST7).

[0065]

[Equation 3]

$$k(v) = \log \frac{v - v_L + \delta_{posi}}{v_U - v + \delta_{nega}} \quad \cdots (6)$$

[0066] The pixel value amendment control section 9 controls pixel value amendment section 8 grade about all the pixels of an input image to compute the pixel correction value k.

[0067] The pixel correction value storage section 10 stores the pixel correction value k of all pixels in reception, memory, etc. from the pixel value amendment control section 9 about all pixels.

[0068] Pixel correction value max and the minimum value calculation section 11 are those maximums kmax and the minimum value kmin, as the pixel correction value of all pixels is read from the pixel

value amendment storage section 10 and it is shown in the following (7) type - (8) type. It computes.
[0069]
kmax =max (k (v0), k (v1), k (v2), --, k (vn))
-- (7)
kmin =min (k (v0), k (v1), k (v2), --, k (vn))
-- (8)
However, n is the total number of pixels.
[0070] The pixel value normalization section 12 reads pixel correction value from the pixel correction value storage section 10, and is the maximum Vmax of an output range, and the minimum value Vmin. It receives, and as shown in the following (9) types, normalization conversion of the pixel correction value k (v) is carried out (ST7).
[0071]
[Equation 4]

$$V(v) = \frac{V_{max} - V_{min}}{k_{max} - k_{min}} (k(v) - k_{min}) + V_{min} \quad \cdots (9)$$

[0072] The pixel value conversion control section 13 computes pixel value conversion value V (v) by the pixel value normalization section 12 about all the pixels of an input image.
[0073] The pixel value normalization conversion value storage section 14 receives and stores pixel value conversion value [of all pixels] V (v) from the pixel value normalization control section 13 about all pixels.
[0074] From the pixel value normalization conversion value storage section 14, the image output section 15 constitutes reception and the whole image, and outputs pixel value conversion value [of each pixel] V (v).
[0075] (Assessment) Next, it states how the contrast and the sharpness of an image are improved by such image quality improvement approach.
[0076] Drawing 5 is drawing showing the subject-copy image before the image quality improvement in the model which modeled the landscape image of the gas station where a bright section, pars intermedia, and dark space exist, on the whole, it has faded and the visibility of the dark space located in the upper half of drawing 5 is low further.
[0077] On the other hand, its visibility of bright sections, such as a car wash and the stand section, is also improving while the image after the image quality improvement by this operation gestalt becomes sharp on the whole, especially the inside of a shop in dark space can check it by looking good unlike a subject-copy image, as shown in drawing 6 .
[0078] By calculating the inputted whole image average vmean, without assuming the distribution property of the brightness value of the inputted image in advance according to the gestalt of the 1st operation, as mentioned above Since the degree which is adapted for distribution of the local brightness values v1-vi, and emphasizes contrast can be adjusted only by processing near [each] the pixel, image quality can be raised by easy count, without requiring decision of a user.
[0079] Specifically, the sharp image which has improved the contrast near each of that pixel can be obtained from the inputted subject-copy image. For example, the luminance signal from an image sensor can be amended to a high-degree-of-accuracy high resolution, or the image quality of the bad image data of contrast can be improved.
[0080] (Gestalt of the 2nd operation) Next, the image quality improvement equipment concerning the gestalt of operation of the 2nd of this invention is explained.
[0081] Drawing 7 is the block diagram showing the configuration of this image quality improvement equipment, it gives the same sign to the same part as drawing 1 , omits that detailed explanation, and describes only a part different here.
[0082] Namely, as the gestalt of this operation aims at an improvement of the contrast of the whole image and specifically shows it to drawing 7 by matching and normalizing average luminance and the

brightness core of a display system in addition to processing of the 1st operation gestalt It replaced with the pixel value normalization section 12 thru/or the image output section 15, and has the whole average correction value calculation section 20, the pixel correction value converter 21, the pixel correction value conversion control section 22, the pixel correction value conversion value storage section 23, and the normalization image output section 24.
[0083] Here, based on multiplier alphaposi and alphanega which were computed by the near average vave computed by the whole average vmean computed by the whole averaging section 2 and the near averaging section 4 and the multiplier calculation section 5, the whole average correction value calculation section 20 computes the correction value k of the whole average vmean (vmean), and has the function to give this correction value k (vmean) to the pixel correction value converter 21.
[0084] The pixel correction value converter 21 compares the correction value k (vmean) computed by pixel correction value [of each pixel] k (v) and the whole average correction value calculation section 20 which were computed by the pixel value amendment section 8. At the time of k(v) <k (vmean), it is the mean value Vmid of output range within the limits about pixel correction value k (v). Linear transform is carried out to the small output range section. At the time of k(v) =k (vmean), it is the mean value Vmid of output range within the limits about pixel correction value k (v). Linear transform is carried out. At the time of k(v) >k (vmean), it is the mean value Vmid of output range within the limits about pixel correction value k (v). By carrying out linear transform to the large output range section Normalization conversion value V (v) is computed by normalizing each pixel correction value k (v) within the limits of an output range, and it has the function to give normalization conversion value V (v) to the pixel correction value conversion control section 22.
[0085] The pixel correction value conversion control section 22 has the function to give normalization conversion value V (v) received from the pixel correction value converter 21 to the pixel correction value conversion value storage section 23, and the function which controls the pixel correction value converter 21 to compute normalization conversion value V (v) about all pixels.
[0086] The pixel correction value conversion value storage section 23 stores in memory etc. each normalization conversion value V (v) received from the pixel correction value conversion control section 22, and the normalization image output section 24 to read-out is possible for it.
[0087] The normalization image output section 24 has the function which constitutes and outputs the whole image based on normalization conversion value [of each pixel memorized in the pixel correction value conversion value storage section 23] V (v).
[0088] Next, the image quality improvement approach by the image quality improvement equipment constituted in this way is explained using the flow chart of drawing 8 .
[0089] Now, suppose that processing to the image input section 1 thru/or the pixel correction value maximum minimum value calculation section 11 was completed like the above-mentioned (ST1-ST7).
[0090] Based on the whole average vmean computed by the whole averaging section 2, using (6) types mentioned above, the whole average correction value calculation section 20 computes the correction value k of the whole average vmean (vmean), and gives it to the pixel correction value converter 21.
[0091] The pixel correction value converter 21 reads pixel correction value k (v) for this correction value k (vmean) from reception and the pixel correction value storage section 20. Moreover, as shown in the following (10) types, they are the maximum Vmax of an output range, and the minimum value Vmin. It receives and is the mean value Vmin. It computes (ST20).
[0092]
[Equation 5]

$$V_{mid} = \frac{V_{max} - V_{min}}{2} \quad \cdots (10)$$

[0093] Subsequently, the whole average vmean is a mean value vmid. Linear transform of the pixel correction value k (v) is carried out like the following (11) type - (12) type so that it may correspond (ST21).

[0094]
[Equation 6]

$$V(v) = \frac{V_{mid}}{k_{max} - k_{mean}} (k(v) - k_{mean}) + V_{mid} \qquad (v \geq V_{mean})$$

… (1 1)

$$V(v) = \frac{V_{mid}}{k_{mean} - k_{min}} (k(v) - k_{min}) + V_{min} \qquad (v < V_{mean})$$

… (1 2)

但し、$k_{mean} = k(v_{mean})$ ·

[0095] The pixel correction value conversion control section 23 controls the pixel correction value converter 21 about all the pixels of an input image to compute pixel correction value conversion value V (v).
[0096] The pixel correction value conversion value storage section 85 stores pixel correction value conversion value [of all pixels] V (v) in reception, memory, etc. from the pixel correction value conversion control section 23 about all pixels.
[0097] The normalization image output section 24 reads pixel correction value conversion value [of each pixel] V (v) from the pixel correction value conversion value storage section 23, and constitutes and outputs the whole image.
[0098] (Assessment) Next, it states how the contrast and the sharpness of an image are improved by this image quality improvement approach.
[0099] Drawing 9 is drawing showing the subject-copy image before the same image quality improvement as drawing 5 .
[0100] On the other hand, reaching in the same sharpness as the above-mentioned, and maintaining the goodness of local contrast further in addition to improvement in the visibility of a bright section and dark space, as the image after the image quality improvement by this operation gestalt is shown in drawing 10 , an overall feeling of contrast increases and natural global contrast stretching is realized.
[0101] Since according to the gestalt of the 2nd operation in addition to the effectiveness of the 1st operation gestalt the correction value k of the whole average value vmean (vmean) is matched with the highly sensitive mean value Vmid of an output range and is normalized as mentioned above, local contrast and global contrast can be emphasized simultaneously.
[0102] The contrast near each of that pixel is improved, the contrast in the whole image is also improved further, it is sharp and, specifically, an image with sufficient visibility can be obtained from the inputted subject-copy image. For example, the luminance signal from an image sensor can be amended to a high-degree-of-accuracy high resolution, or the image quality of the bad image data of contrast can be improved.
[0103] (Gestalt of the 3rd operation) Next, the edge on-the-strength count equipment concerning the gestalt of operation of the 3rd of this invention is explained. Drawing 11 is the block diagram showing the configuration of this edge on-the-strength count equipment, it gives the same sign to the same part as drawing 1 , omits that detailed explanation, and describes only a part different here.
[0104] Namely, as the gestalt of this operation outputs an edge image on the strength and specifically shows it to drawing 11 according to deformation of the 1st operation gestalt It replaces with the pixel value amendment section 8 thru/or the image output section 15. The near image pixel value maximum inclination value calculation section 30, the edge on-the-strength calculation section 31, the edge on-the-strength computing control section 32, the edge on-the-strength value storage section 33, the edge on-the-strength value maximum minimum value calculation section 34, the edge on-the-strength value normalization section 35, the edge on-the-strength value normalization control section 36, the edge on-

the-strength value normalization conversion value storage section 37 And it has the edge on-the-strength image output section 38.
[0105] Here, the image pixel value maximum inclination value calculation section 30 computes the maximum inclination value dv (v) which shows max among the absolute values of each inclination which met in two or more predetermined directions which can be set between each brightness value v1 of the near pixel extracted by the image extract section 3 soon - vi, and has the function give this maximum inclination value dv (v) to the edge on-the-strength calculation section 31 soon.
[0106] The edge on-the-strength calculation section 31 has a positive image edge on-the-strength value calculation function, a negative image edge on-the-strength value calculation function, and the edge on-the-strength calculation function that computes the edge value dk of a pixel on the strength (v).
[0107] A positive image edge on-the-strength value calculation function is the processing which computes a positive image edge value on the strength by being as a result of [concerned] correction, and **(ing) the maximum inclination value dv (v) to be received from the pixel maximum inclination value calculation section 30 soon while it adds pixel value variate deltaposi determined by the positive image pixel value variate decision section 6 to the relative value of the brightness value v of the pixel concerned in a positive image and corrects this relative value.
[0108] A negative image edge on-the-strength value calculation function is the processing which computes a negative image edge value on the strength by being as a result of [concerned] correction, and **(ing) the maximum inclination value dv (v) to be received from the pixel maximum inclination value calculation section 30 soon while it adds pixel value variate deltanega determined by the negative image pixel value variate decision section 7 to the relative value of the brightness value v of the pixel concerned in a negative image and corrects this relative value.
[0109] An edge on-the-strength calculation function is processing which computes the edge value dk of the pixel concerned on the strength (v) by applying mutually the positive image edge value on the strength and the negative image edge value on the strength which were computed by both [these] functions, and gives this edge value dk on the strength (v) to the edge on-the-strength computing-control section 32.
[0110] The edge on-the-strength computing control section 32 has the function to give the edge value dk on the strength (v) received from the edge on-the-strength calculation section 31 to the edge on-the-strength value storage section 33, and the function which will control the image extract section 3 thru/or the edge on-the-strength calculation section 31 soon to compute the edge value dk on the strength (v) about all pixels.
[0111] The edge on-the-strength value storage section 33 stores in memory etc. each edge value dk on the strength (v) received from the edge on-the-strength computing control section 32, and the edge on-the-strength value maximum minimum value calculation section 34 to read-out is possible for it.
[0112] The edge on-the-strength value maximum minimum value calculation section 34 is the maximum dkmax among all the edge values dk on the strength (v) memorized in the edge on-the-strength value storage section 33. Minimum value dkmin It has the function which is computed and is given to the edge on-the-strength value normalization section 35.
[0113] the maximum dkmax which receives the edge on-the-strength value normalization section 35 from the edge on-the-strength value maximum minimum value calculation section 34 And the minimum value dkmin the function of being based, normalizing the edge value dk of each pixel memorized in the edge on-the-strength value storage section 33 on the strength (v) within the limits of an output range, computing the normalization conversion value dV (v), respectively, and giving these normalization conversion value dV (v) to the edge on-the-strength value normalization control section 36 -- **** -- it is.
[0114] The edge on-the-strength value normalization control section 36 has the function to give the normalization conversion value dV (v) received from the edge on-the-strength value normalization section 35 to the edge on-the-strength value normalization conversion value storage section 37, and the function which controls the edge on-the-strength value normalization section 35 to compute the normalization conversion value dV (v) about all pixels.

[0115] The edge on-the-strength value normalization conversion value storage section 37 stores in memory etc. each normalization conversion value dV (v) received from the edge on-the-strength value normalization control section 36, and the edge on-the-strength image output section 38 to read-out is possible for it.
[0116] The edge on-the-strength image output section 38 has the function which constitutes and outputs the whole image based on the normalization conversion value dV of each pixel memorized in the edge on-the-strength value normalization conversion value storage section 37 (v).
[0117] Next, the edge on-the-strength count approach by the above edge on-the-strength count equipments is explained using the flow chart of drawing 12 .
[0118] Now, suppose that processing to the image input section 1 thru/or the negative image pixel value variate decision section 7 was completed like the above-mentioned (ST1-ST6).
[0119] The image pixel value maximum inclination value calculation section 30 will calculate the absolute value of the pixel value variation in the four directions of the upper and lower sides of an attention pixel, right and left, left slant, and right slant, among those will make the greatest thing the pixel value maximum inclination value dv soon.
[0120] the edge on-the-strength calculation section 31 -- the positive image pixel value variate decision section 6 -- positive image pixel value variate deltaposi -- reception and the negative image pixel value variate decision section 7 -- negative image pixel value variate deltanega -- reception -- the image pixel value maximum inclination value dv will be further received from the image pixel value maximum inclination value calculation section 30 soon.
[0121] Then, the edge on-the-strength calculation section 31 is the lower limit vL of the pixel value v of an attention pixel to an image, as shown in the following (13) types. Add positive image pixel value variate deltaposi to the deducted value, and a positive image pixel value is calculated. moreover, upper limit vU of an image Negative image pixel value variate deltanega is added to the value which deducted the pixel value v of an attention pixel, and a negative image pixel value is calculated. from -- with a positive image pixel value The image pixel value maximum inclination value dv will be broken soon, and it asks for a quotient, and considers as a positive image edge value on the strength. With moreover, a negative image pixel value The pixel pixel value maximum inclination value dv will be broken soon, and it asks for a quotient, and considers as a negative image edge value on the strength, and the linear combination of a positive image edge value on the strength and a negative image edge value on the strength is computed further, and it considers as the edge value dk of the pixel concerned on the strength (v) (ST30).
[0122]
[Equation 7]

$$dk(v) = \frac{dv}{v - v_L + \delta_{posi}} + \frac{dv}{v_U - v + \delta_{nega}} \quad \cdots (13)$$

[0123] The edge on-the-strength computing control section 32 controls the edge on-the-strength calculation section 31 about all the pixels of an input image to compute the edge value of the pixel concerned on the strength.
[0124] The edge on-the-strength value storage section 33 stores the edge value dk of all pixels on the strength (v) in reception, memory, etc. from the edge computing control 32 on the strength.
[0125] Edge on-the-strength value max and the minimum value calculation section 34 are those maximums dkmax and the minimum value dkmin, as the edge value dk of all pixels on the strength (v) is read from the edge on-the-strength value storage 33 and it is shown in the following (14) type - (15) type. It computes.
[0126]
dkmax =max (dk (v0), dk (v1), dk (v2), --, dk (vn))
-- (14)
dkmin =min (dk (v0), dk (v1), dk (v2), --, dk (vn))

-- (15)
However, n is the total number of pixels.
[0127] The edge on-the-strength value normalization section 35 the edge value dk on the strength over the pixel value v of an attention pixel (v) Reception, They are the maximum dkmax of an edge value on the strength, and the minimum value dkmin from edge on-the-strength value max and the minimum value calculation section 34. As shown in reception and the following (16) types It normalizes in the domain [vL and vU] of the variate to which each pixel value can take the edge value dk on the strength (v), and the edge on-the-strength value normalization conversion value dV (v) is calculated (ST31).
[0128]
[Equation 8]

$$dV(v) = \frac{v_U - v_L}{dk_{max} - dk_{min}} (dk(v) - dk_{min}) + v_L \quad \cdots (16)$$

[0129] The edge on-the-strength value normalization conversion control section 36 controls the edge on-the-strength value normalization section 35 about all the pixels of an input image to compute the edge on-the-strength value normalization conversion value dV (v).
[0130] The edge on-the-strength value normalization conversion value storage section 37 receives and stores the edge on-the-strength value normalization conversion value dV of all pixels (v) about all pixels from the edge on-the-strength value normalization conversion control section 36.
[0131] The edge on-the-strength image output section 38 reads the edge on-the-strength value normalization conversion value dV of each pixel (v) from the edge on-the-strength value normalization conversion value storage section 37, and constitutes and outputs the whole edge image (differential image) on the strength.
[0132] (Assessment) Next, it states how the edge reinforcement of an image is expressed by such edge on-the-strength count approach.
[0133] Drawing 13 is drawing showing the same subject-copy image as drawing 5 .
[0134] On the other hand, as the edge image on the strength by this operation gestalt is shown in drawing 14 , in pars intermedia, the structure of the inside of a shop which cannot be checked has appeared well by the subject-copy image especially from dark space. Moreover, in the pars intermedia from a bright section, fine structures, such as a car wash and the stand section, are clear especially. That is, the high output of an edge enhancement effect is obtained by both the bright section and dark space.
[0135] Since edge reinforcement is computed after the same contrast stretching as the 1st operation gestalt according to the gestalt of the 3rd operation as mentioned above, without requiring decision of a user to the image of most including the object and structure of a bright section and dark space fine at both, by easy count, calculation and edge detection of accurate edge reinforcement can be performed, and the outstanding edge enhancement image can be outputted.
[0136] That is, since edge reinforcement is calculated by improving the contrast near each of that pixel substantially from the inputted subject-copy image, unlike the former, the fine edge in a bright section and dark space is also detectable. For example, edge detection of the luminance signal from an image sensor can be carried out to a high-degree-of-accuracy high resolution, or the structure of image data with bad visibility, such as a bright section and dark space, etc. can be detected now to high degree of accuracy.
[0137] (Gestalt of other operations) In addition, in the gestalt of the 1st thru/or the 3rd operation, area size may be fixed to a suitable value soon, or you may give suitably as a parameter. As an area size, it is desirable to make a radius into 3-4 pixels in an abbreviation concentric circle-like field, and it is desirable to make area into 20-40 pixels soon.
[0138] Moreover, in the gestalt of the 1st thru/or the 3rd operation, the value of betaposi and betanega may be fixed to a suitable value, or you may give suitably as a parameter.
[0139] Moreover, the technique indicated in the above-mentioned operation gestalt can also be stored and distributed to storages, such as magnetic disks (a floppy disk, hard disk, etc.), optical disks (CD-

ROM, DVD, etc.), and semiconductor memory, as a program which a computer can be made to execute.

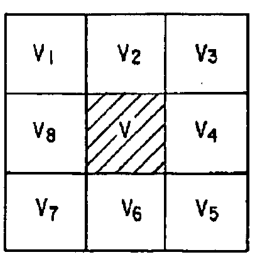
[0140] In addition, in the range which does not deviate from the summary, this invention deforms variously and can be carried out.
[0141]
[Effect of the Invention] As mentioned above, as explained, according to the image quality improvement approach and equipment of this invention, the increase of local sharpness, local contrast, and global contrast of the image inputted from the monitor camera, the digital camera, etc. are substantially improvable.
[0142] Moreover, according to the edge on-the-strength count approach and equipment of this invention, by the conventional edge on-the-strength count approach, the undetectable fine shade change in a bright section and dark space can be detected, and good edge detection can be realized over the whole region of brightness.

[Translation done.]

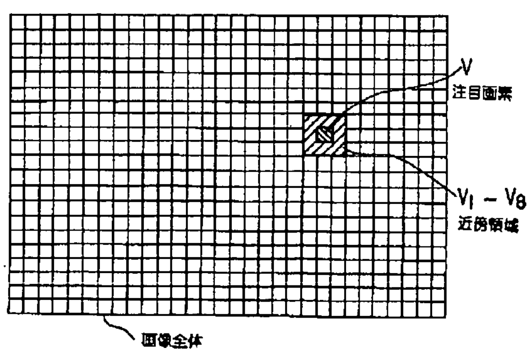
の構成を示すブロック図
【図２】同実施の形態における動作を説明するためのフローチャート
【図３】同実施の形態における注目する画素とその近傍の画素とを説明するための模式図
【図４】同実施の形態における画像全体と注目画素とその近傍画素との関係を示す模式図
【図５】同実施の形態における画質改善前の原画像を写真印刷して示す図
【図６】同実施の形態における画質改善後の画像を写真印刷して示す図
【図７】本発明の第２の実施の形態に係る画質改善装置の構成を示すブロック図
【図８】同実施の形態における動作を説明するためのフローチャート
【図９】同実施の形態における画質改善前の原画像を写真印刷して示す図
【図１０】同実施の形態における画質改善後の画像を写真印刷して示す図
【図１１】本発明の第３の実施の形態に係るエッジ強度計算装置の構成を示すブロック図
【図１２】同実施の形態における動作を説明するためのフローチャート
【図１３】同実施の形態におけるエッジ強度計算前の原画像を写真印刷して示す図
【図１４】同実施の形態におけるエッジ強度計算後のエッジ強度画像を写真印刷して示す図
【図１５】従来の線形変換による画質改善方法を説明するための図
【図１６】従来の対数変換又は指数変換による画質改善方法を説明するための図
【図１７】従来の指数変換による画質改善方法を説明するための図

【符号の説明】
１…画像入力部
２…全体平均算出部
３…近傍画像抽出部
４…近傍平均算出部
５…係数算出部
６…ポジティブ画像画素値変量決定部
７…ネガティブ画像画素値変量決定部
８…画素値補正部
９…画素値補正制御部
１０…画素補正値記憶部
１１…画素補正値最大最小値算出部
１２…画素値正規化部
１３…画素値正規化制御部
１４…画素値正規化変換値記憶部
１５…画像出力部
２０…全体平均補正値算出手段
２１…画素補正値変換部
２２…画素補正値変換制御部
２３…画素補正値変換値記憶部
２４…正規化画像出力部
３０…近傍画像画素値最大勾配値算出部
３１…エッジ強度算出部
３２…エッジ強度計算制御部
３３…エッジ強度値記憶部
３４…エッジ強度値最大最小値算出部
３５…エッジ強度値正規化部
３６…エッジ強度値正規化変換制御部
３７…エッジ強度値正規化変換値記憶部
３８…エッジ強度画像出力部

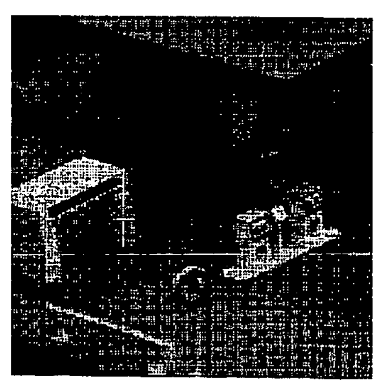
【図３】



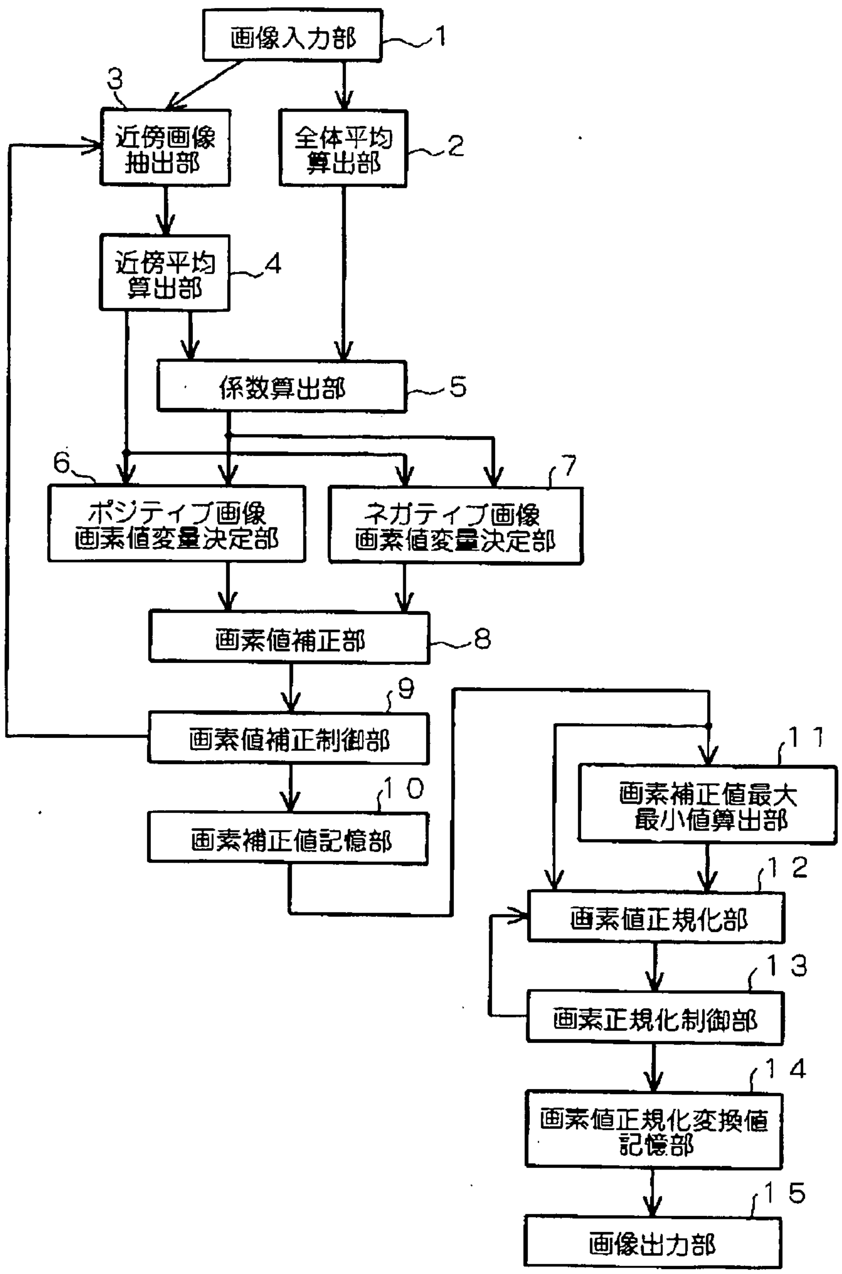
【図４】



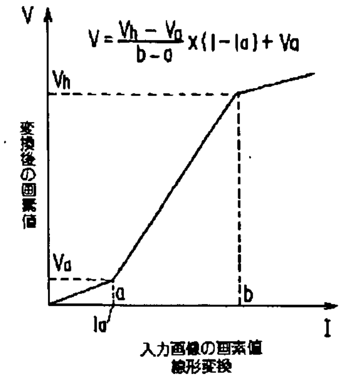
【図５】



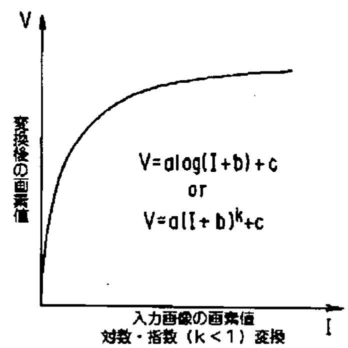
【図1】



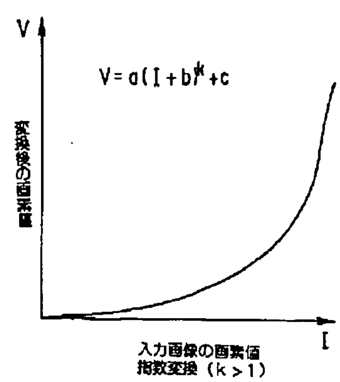
【図15】



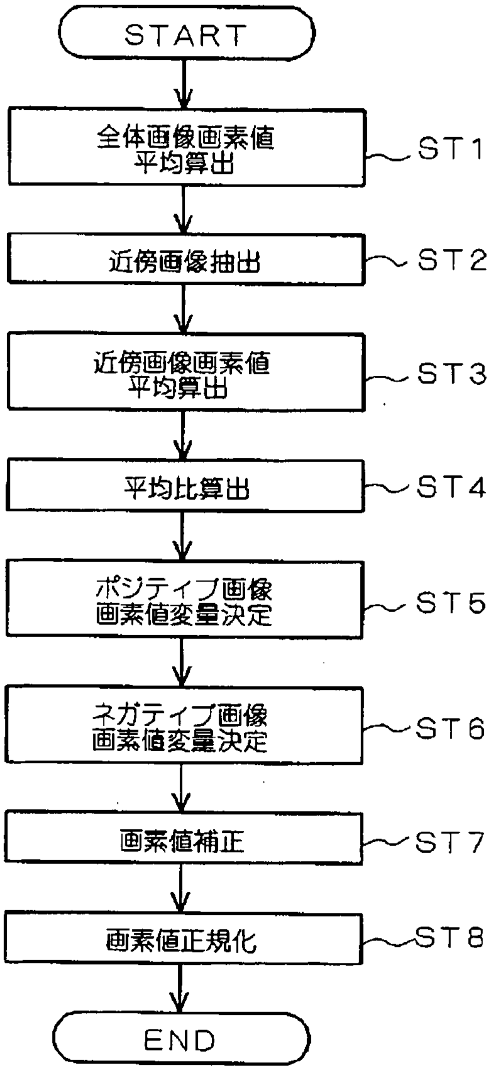
【図16】



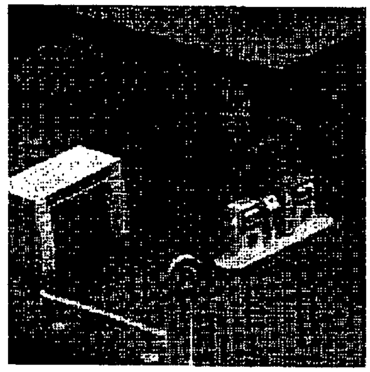
【図17】



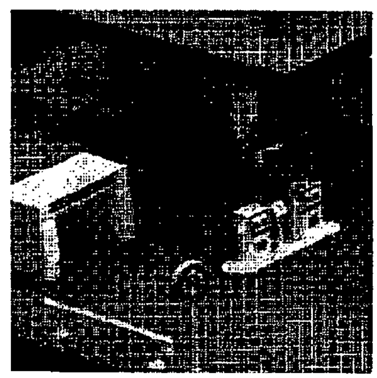
【図2】



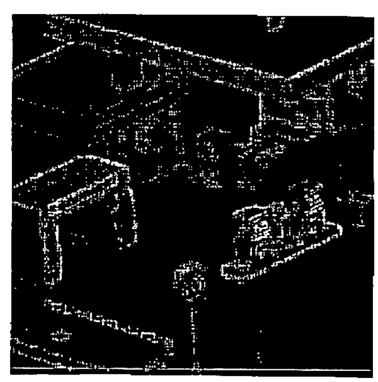
【図6】



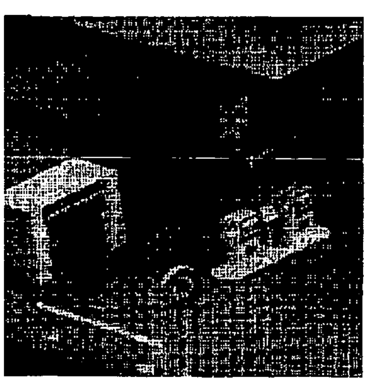
【図13】



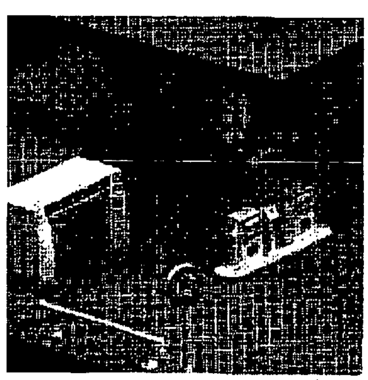
【図14】



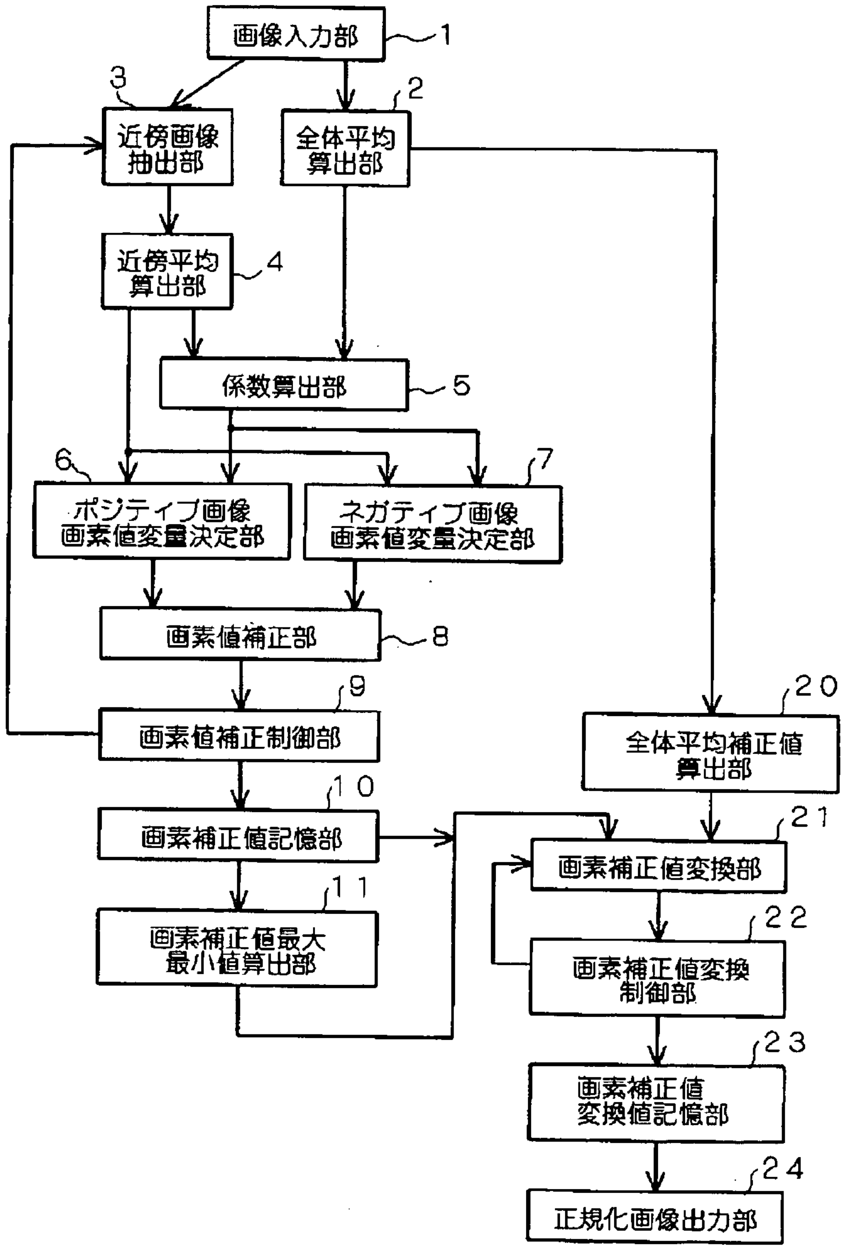
【図9】



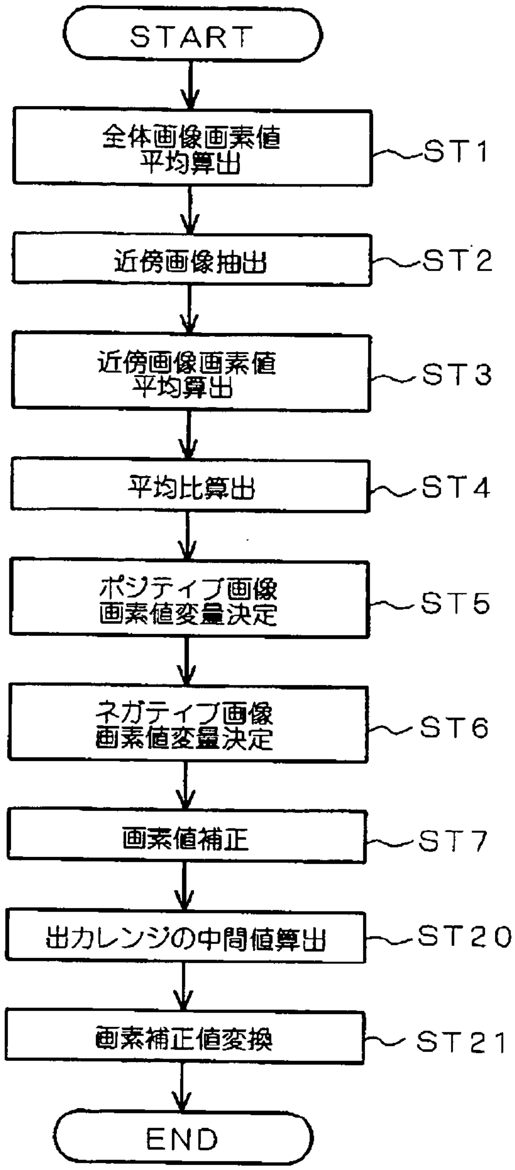
【図10】



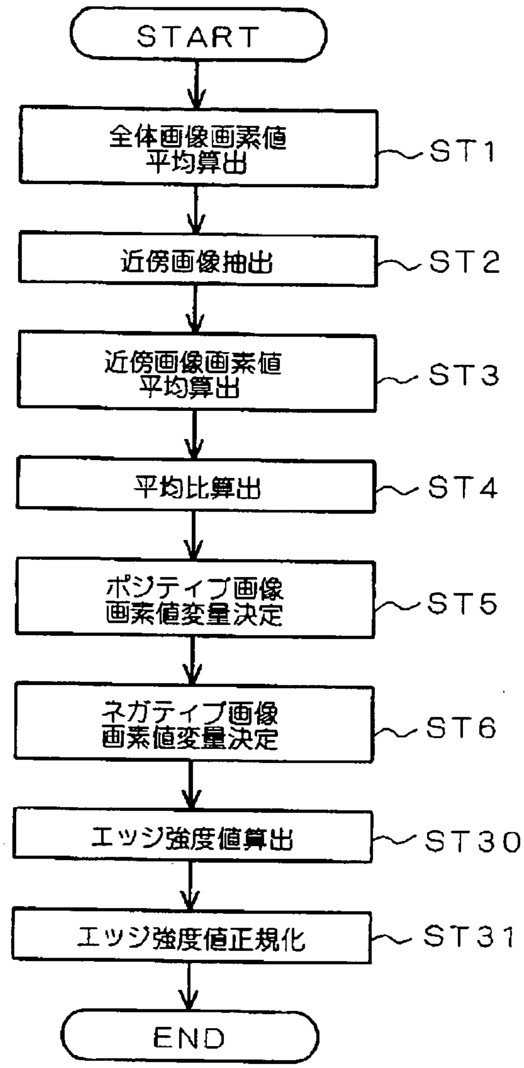
【図7】


画像入力部
1
3
2
近傍画像抽出部
全体平均算出部
近傍平均算出部
4
係数算出部
5
6
7
ポジティブ画像画素値変量決定部
ネガティブ画像画素値変量決定部
画素値補正部
8
9
画素値補正制御部
20
全体平均補正値算出部
10
画素補正値記憶部
21
画素補正値変換部
11
画素補正値最大最小値算出部
22
画素補正値変換制御部
23
画素補正値変換値記憶部
24
正規化画像出力部

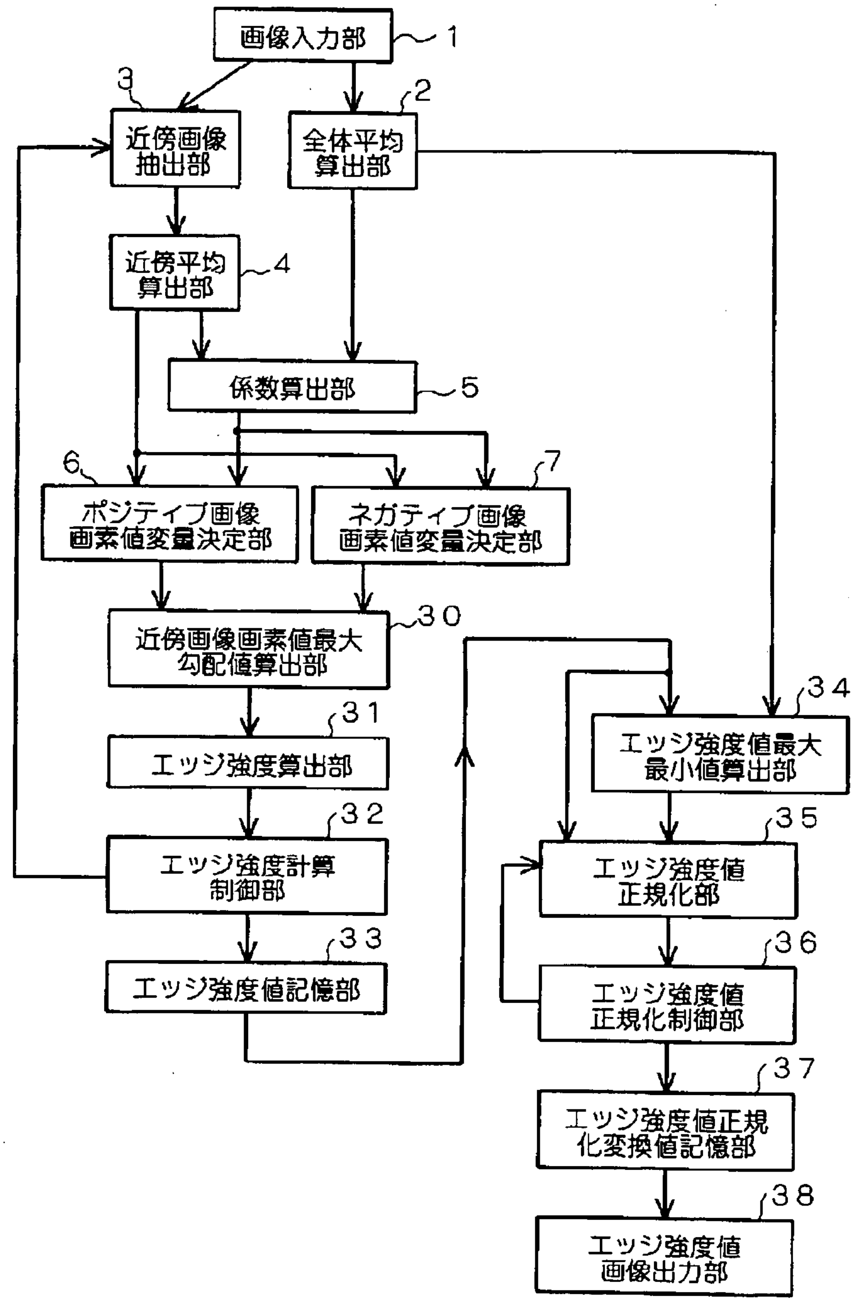
【図8】


START
全体画像画素値
平均算出
ST1
近傍画像抽出
ST2
近傍画像画素値
平均算出
ST3
平均比算出
ST4
ポジティブ画像
画素値変量決定
ST5
ネガティブ画像
画素値変量決定
ST6
画素値補正
ST7
出力レンジの中間値算出
ST20
画素補正値変換
ST21
END

【図12】


START
全体画像画素値
平均算出
ST1
近傍画像抽出
ST2
近傍画像画素値
平均算出
ST3
平均比算出
ST4
ポジティブ画像
画素値変量決定
ST5
ネガティブ画像
画素値変量決定
ST6
エッジ強度値算出
ST30
エッジ強度値正規化
ST31
END

【図11】



フロントページの続き

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